Construction and operation of the pipeline and appurtenant facilities would not interfere with current and future exploitation of oil and natural gas resources due to the depth at which these resources occur. A total 15 gas and oil fields would be crossed by the pipeline (see table 4.1.2-1). Millennium would avoid existing oil and gas lines associated with these fields to the extent necessary and, through the state One-Call system, would notify land and resource owners of pipeline construction planned in the vicinity of their facilities. Owners of existing oil and gas lines would be responsible for marking their lines and witnessing the excavation of the trench.

Millennium would install its pipeline with a minimum of 12 inches of clearance from any other pipeline or underground structure. Where these clearances cannot be attained, suitable precautions, such as installation of protective material or casing, would be used. If, during pipeline construction, the free span of the existing line is sufficient to induce stress on the foreign pipe, it would be supported with timbers, sandbags, or similar temporary materials. If any foreign pipeline is inadvertently ruptured during pipeline construction, containment and cleanup would be performed in accordance with the procedures identified in Millennium's Spill Prevention, Containment, and Control Plan (SPCC Plan) which is included in its ECS in appendix E1. Since the pipeline would not cross active or abandoned coal mines, contaminated mine runoff would not pose a potential hazard.

Geologic Hazards

Geologic hazards that can impact pipeline construction and operation include landslides earthquakes, and karst terrain.

Landsliding does not pose a widespread hazard in the project area. Any impact would be related to natural processes or adverse geologic conditions that could be aggravated by pipeline construction. Artificial cutting along slopes, artificial loading by construction equipment along the proposed right-of-way, and abnormally high precipitation may increase landslide susceptibility. Landsliding in the project area is limited to shallow earth flows, soil creep, and minor debris avalanches. Earth flow hazards exist along river banks where alluvial deposits are easily eroded by river scour. Soil creep is an almost imperceptibly slow downslope mass movement that can potentially accelerate to slope slumps or slides. Soil creep would not be of short-term concern to the pipeline, but if unchecked, soil creep might bend and weaken pipeline over time. Creep would be most significant on sidehill installations in thick glaciolacustrine deposits and in thin mantles of outwash underlain by glaciolacustrine material. Proper pre- and post-construction inspections would identify areas of risk, and continued monitoring along slopes would likely identify any significant landslide hazards before they were to develop. Furthermore, use of the two-toning 2/ construction technique and strict adherence to the erosion control, revegetation, and right-of-way maintenance procedures (included in appendix E) would minimize any potential for mass wasting and consequent slope instability.

Seismicity includes surface faulting, ground shaking, and earthquake-induced phenomena such as soil liquefaction. Surficial faulting poses the greatest seismic hazard to natural gas pipelines. No faults active within the past 10,000 years would be crossed by any segment of the pipeline (Howard et al, 1978). While numerous earthquakes resulting in slight-to-moderate ground shaking have been reported in the vicinity of the project area, no adverse impact on the pipeline would be anticipated since modern natural gas pipelines exhibit good inherent ductility. Seismic hazard would be limited to a large scale catastrophic earthquake. The likelihood of such an earthquake during the design life of the pipeline facilities is remote.

2/ Two-toning is often used in side hill construction and involves cutting the side slope and using the fill to establish two level workspaces on the side hill, one for equipment passage and one for the trench.

Severe ground vibrations in cohesionless saturated soils can cause temporary increases in pore water pressure. This phenomenon may cause soils to liquefy. Due to the small percentage of susceptible soils and the seismic history of the project area, liquefaction should not affect construction and operation of the pipeline and appurtenant facilities.

Subsidence from either karst development or underground mining could result in loss of bearing, weakening or even rupturing underground pipelines. Millennium identified shallow carbonate rock formations that may be susceptible to karst at MP 87.3, and between MPs 330.3 and 340.1, MPs 340.5 and 341.2, MPs 349.5 and 352.0, MPs 353.1 and 353.6, and MPs 355.4 and 362.4. However, geologic hazard due to subsidence is remote. Only very large rapidly forming sinkholes would be a significant concern to welded steel pipelines. Such sinkholes are not known to exist in the project area. Furthermore, sinkhole development near the surface would be identified through aerial inspections, ground patrol, and leak detection surveys. If properly filled and stabilized, any cavity at or near the surface should not pose a hazard to pipeline construction or operation.

5.1.2 Site-Specific Impact

Millennium identified one area at Chautauqua Creek (MP 43.0), where the banks are very steep with wet gravelly soils that may be susceptible to landslide. Millennium states that landslide mitigation may include benching the slopes (e.g., two-toning) or the use of additional right-of-way width. However, while safety and spoil storage space requirements would need to be considered, the construction work area requirements would be minimized as much as possible because of the unique features of the gorge. See further discussion and recommendation for the Chautauqua Creek Gorge in section 5.5.2 and table 5.8.3.2-1.

We received a comment regarding the proposed route which may affect unique geologic formations in the Rock City State Forest. The pipeline would cross the NYSDEC's State Reforestation Land 8, which contains an area known as Rock City near MP 90.5. Millennium estimates that the crossing length would be about 6,132 feet and that the construction work area would be about 800 to 1,000 feet north and west of the Rock City area and the associated geologic formations. Millennium has not identified any unique geologic features that would require blasting or other special construction procedures. Access has been denied by a nearby landowner who commented that his property (three parcels between approximate MPs 90.5 and 91.3) contained the "Rock City" geologic formations. Millennium would assess any unique geologic features and determine whether special construction techniques or mitigation measures are warranted after access to this property is granted. We recommend that:

- **Millennium file with the Secretary of the Commission (Secretary) the results of surveys conducted in the area between MPs 90.5 and 91.3 when access is obtained, and any mitigation plans proposed to avoid impact on the "Rock City" geologic formations for review and written approval of the Director of the Office of Pipeline Regulation (OPR).**

Another landowner commented that he would like Millennium to remove an old existing oil pipeline near MP 227.0. Millennium stated that this pipeline is about 150 feet north of the proposed pipeline and that it has no plans to remove other pipelines. We cannot recommend removal of the oil pipeline since it would require disturbance outside of Millennium's construction work area and its removal would not be required for installation of the proposed pipeline.

The owner of the bluestone quarry near MP 269.7 commented that construction of the pipeline would disrupt mining operations. Millennium commented that the pipeline would be about 1,250 feet south of this quarry, which is not operational and does not have a valid mining permit. A second non-active mining operation in the same area is on Bryce Road. Access would be maintained on Bryce Road throughout construction. If the quarry is reactivated and should extend into the permanent right-of-way, the 50-foot-wide easement could not be mined. This would be taken into consideration during easement negotiations or subsequent damage payments.

The NYSDEC commented that disturbance of old and existing gas/oil production well lines, which are at or near the surface, could result in spills that could impact water quality. Millennium's ECS includes an SPCC Plan that addresses how Millennium would contain and cleanup inadvertent spills (see section V [page 21] of the ECS in appendix E1). These procedures include the provision that the contractor's foreman and inspector's vehicles be equipped with spill kits containing absorbent materials for petroleum products. We believe that implementation of these procedures would allow for rapid containment and cleanup of spills, including those within oil/gas production fields.

5.2 SOILS

The impact of construction on soils can be effectively reduced through use of appropriate erosion control and revegetation plans. A number of comments were received during the scoping process on the issue of erosion control and the protection of agricultural land during construction. Millennium would implement the procedures identified in its ECS, which incorporates our Plan as well as specific recommendations made by the NYSDA&M (see appendix E). Implementation of the ECS and our Plan would minimize the potential for erosion, soil compaction, introduction of rock into topsoil, and poor or very poor revegetation. Millennium would also employ at least one agricultural inspector for each spread in addition to the other environmental inspectors. The agricultural inspector would be qualified to handle all aspects of agricultural management and would be responsible for construction activities being done in accordance with the agricultural conditions of the ECS (section III.A through III.H) and other pertinent requirements. All erosion and sedimentation control permits required by the state would be filed with the Commission.

5.2.1 General Construction and Operational Impacts

Pipeline construction and operation could adversely affect soils in several ways. Potential increases in soil erosion (from water and/or wind), loss of soil productivity through soil compaction, damage to soil structure, loss of soil fertility by inversion of soil horizons (i.e., mixing of topsoil and subsoil), and damage to drainage tile systems could result in poor or very poor revegetation, which is necessary for stabilization and restoration of the construction right-of-way. Most of New York's soils are glacially derived and have a thin (about 3 to 12 inches thick) layer of topsoil.

Soil Erosion

Potentially, one of the most severe impact on soils from pipeline construction is erosion. Many stages of pipeline construction, including vegetation clearing, grading, topsoil segregation, open trenching and backfilling destabilize the soil material and make it susceptible to water and wind erosion. The most susceptible time for erosion to occur is after initial vegetative clearing and grading and before reestablishment of a vegetative cover. A soil's susceptibility to erosion varies and is a function of its characteristics, such as soil texture, structure, topography (steepness of slope), amount of surface cover (vegetative or other), and climate. Erosion potential increases the longer soils are left bare. Erosion from water primarily occurs in loose soils on moderate to steep slopes. Many glacial till subsoils are proportionally high in silt and remain better bonded than sandier subsoils when exposed. However, gullying can occur along backfilled trenches with their destabilized spoil (subsoil and substrata) materials.

Wind erosion can occur in dry, sandy soils where vegetative cover is difficult to establish and maintain. Soil erosion could also result from off-road vehicle traffic, resulting in ruts and gullies on the sloped portions of the right-of-way following construction.

Soil erosion for all affected soils can be reduced with both temporary and permanent erosion control practices. These controls include temporary and permanent structures such as slope breakers, sediment barriers, and trench barriers and breakers. An erosion hazard can also be reduced by stabilizing the soil surface with temporary and permanent planting and mulching, minimizing the time of soil disturbance, avoiding construction during periods of maximum runoff, and reestablishing contours and vegetative cover as soon as possible. Many potential impacts from soil erosion can be reduced by minimizing the duration of time between initial grading and backfilling and restoration of the right-of-way.

Soil Compaction and Damage to Soil Structure

The movement of heavy construction equipment back and forth along the construction right-of-way and access roads can result in soil compaction. This can have severe impact in agricultural and residential areas. Soil compaction damages soil structure and reduces pore space which impedes the movement of air and water to plant roots, resulting in loss of soil productivity and lower growth rates. Damage to soil structure makes soils more susceptible to erosion and inhibits natural drainage. When soils are wet, compaction and rutting invert the fertile topsoil and the poor fertility subsoil. Generally, soil is most prone to structural damage during the wettest part of the spring and fall seasons, or in areas of poor drainage. However, abundant year-round moisture in the Northeast makes the vast majority of glacial till, alluvial, and lacustrine soils prone to compaction and structural damage during and following each heavy rainstorm. Clodding and/or rutting at shallow depths complicates planting in agricultural areas and can increase the erosion potential.

Mitigation measures to reduce soil compaction and soil horizon inversion begin with scheduled avoidance of heavy construction and restoration during excessively wet spring and fall periods. Topsoil segregation and subsurface plowing (deep ripping and soil-profile shattering), particularly in agricultural areas, can help control and mitigate the multiple effects of soil compaction due to construction. Millennium's agricultural inspectors, in consultation with the NYSDA&M, would be responsible for determining if soil and weather conditions are suitable for construction or restoration activities in agricultural fields (see recommendation in section 5.2.2).

Loss of Soil Fertility

Trenching and backfilling, as well as the concentrated movement of construction equipment along the construction right-of-way, can result in severe mixing of topsoil and subsoil and can dilute the productivity of the soil by mixing the physical and chemical properties of the topsoil with the low fertility subsoil. This is especially true in the thin, glacially derived loams of the Northeast. In addition, construction activities, including trench blasting in shallow to bedrock soils, could introduce rock into topsoil and interfere with operation of agricultural equipment.

Mitigation measures include topsoil segregation before trenching in cropland, hay and improved pasture land, wetlands (without saturated soils or standing water), and residential areas, and the removal of excess rock having a 4-inch or greater diameter from the disturbed portions of the soil profile (soil horizons) during the progressive phases of soil restoration as required in Millennium's ECS. However, even with careful topsoil segregation, some mixing of the topsoil and subsoil can occur during backfilling and restoration. Following construction, the rock content of the disturbed area would be comparable to the surrounding undisturbed areas. Fly-rock from blasting can be contained by matting or controlled blasting techniques. Although some loss of soil fertility may be expected immediately following construction, these measures can help minimize the severity and duration of the impact.

Noxious Weeds or Soil Pests

Construction equipment traveling from noxious weed-infested fields into previously weed-free areas could facilitate the dispersal of noxious weed seed and propagules, and could result in the establishment of noxious weeds in areas where none or relatively few existed before construction. The degree of this impact would depend on the species of weed, its prevalence in the area prior to construction, and the intensity of the construction-induced dispersal. Millennium identified wetlands with the exotic noxious weed purple loosestrife east of MP 354.0. This species is invasive and has the potential to be spread to other wetlands and streams by construction activities. Millennium has consulted with the U.S. Department of Agriculture regarding the parasitic nematode. None are believed to be present. If found, Millennium would implement appropriate mitigation in consultation with the appropriate agencies and the NYSDA&M as necessary to prevent the spread of noxious weeds or soil pests (see section 5.7.3 for further discussion of purple loosestrife).

Poor Revegetation

Revegetation is necessary for the stabilization and restoration of the construction right-or-way. Revegetation potential is subject to increases in soil erosion (from water and/or wind), loss of soil productivity through soil compaction, damage to soil structure, loss of soil fertility (i.e., mixing of topsoil and subsoil), damage to drainage tile systems, seeding methods, and planting conditions. The effect of construction on these factors could lead to poor or very poor revegetation potential.

Mitigation measures include soil additives and seeding requirements in accordance with written recommendations obtained from the local soil conservation authority or land management agencies. To minimize the time bare soils are exposed, Millennium is required to complete final grading within 10 calendar days of backfilling, weather and soil conditions permitting. If unsuitable soil conditions for final grading persist for more than 14 calendar days, temporary stabilization measures (including temporary seeding or mulching) would be completed. However, in no case would final grading be delayed beyond the next seeding season.

Millennium has contacted local NRCS district offices for recommendations regarding seed mix requirements, which would be included along with appropriate agency recommendations, on the construction alignment sheets. The proposed seeding mixes are listed in table 2a of the ECS (see appendix E1). Additional correspondence received from agencies would be filed with the Commission. Millennium has contacted NRCS with regard to CRP land and has been working with the NYSDA&M and Cooperative Extension Bureaus to minimize impacts on these and all other agricultural lands.

Restoration work would be performed by personnel familiar with local horticultural and turf management practices. Post-construction monitoring would be conducted for at least two years to determine the need for additional restoration. The NYSDA&M stated that a two-year monitoring program is important to realistically assess soil impacts, such as reduced crop productivity, drainage problems, soil compaction, topsoil settling over the trench, and excess rock. In accordance with its ECS and our Plan, Millennium would monitor the construction work area for 2 years following completion of restoration activities by persons knowledgeable in soils issues. Any required mitigation (e.g., importing of additional topsoil, performing additional decompaction, and/or installing additional drain tiles) would be done by Millennium. Routine vegetative maintenance clearing would not be done more frequently than every three years, except to facilitate periodic corrosion and leak surveys.

Because off-road vehicles can affect revegetation on the right-of-way and contribute to rutting and soil erosion, efforts would be made to control unauthorized off-road vehicle use of the right-of-way.

Potential Changes to Drainage

Movement of heavy construction equipment along the construction right-of-way could cause breakage or misalignment of drain tiles. Trenching could also cause drain tile damage and obliterate old "stone drain" lines, affecting farm managment (tillage, planting, and harvesting) by causing wet unworkable conditions. This would lower future crop production if such damage is not corrected. Although the location of old, yet functioning, stone drains can seldom be determined before construction, the mitigation of drain tile damage can be helped by locating the fields with drain tiles during preconstruction consultation with landowners and appropriate federal, state, and local conservation agencies. Drain lines that may be affected by construction would then be clearly staked before construction. Tile damage from vehicular movement or trenching would be repaired by probing the tile to determine the extent of misalignment, or breakage, and replacing the damaged sections. Affected stone drains are usually more difficult to detect, until the damage is noted by concentrated seepage and saturation during or after construction. Damaged stone drain systems in the project area can not be repaired and would be mitigated with replacement drain tile systems.

Millennium has contacted landowners and the local NRCS to identify the locations of drainage tiles and has identified those fields with drainage tiles on its construction alignment sheets. Millennium proposes to bury the pipeline with a minimum of 4 feet of cover to allow 1 foot of cover under the drainage tile, and to repair or replace any tiles that are broken or damaged (see section III of Millennium's ECS). All agricultural areas would be monitored for crop productivity for 2 years following construction and appropriate mitigation (i.e., additional decompaction, additional rock removal, and/or installing additional drain tiles, etc.) would be done as necessary to correct for reduced crop productivity.

Trenching, as well as sideling (cross slope) construction grading can alter the natural, lateral drainage pathways along the subsoil horizons of many glacial tills and other affected soils by obliterating the natural planes of drainage and by the resultant expansion, or creation, of concentrated points of seepage, or drainage accumulation, along the trench or the side cut. These impacts would be mitigated after the extent of damage has been monitored as part of the post-construction monitoring program.

5.2.2 Site-Specific Impact

Millennium's construction alignment sheets (CAS) and associated construction alignment sheet notes detail the placement of erosion controls, the locations of drainage tiles and topsoil segregation, and other site-specific construction requirements developed in consultation with the NYSDA&M, the NYSDEC, and others. The NYSDA&M's concerns include implementation of its agricultural mitigation standards, as outlined in its "Pipeline Right-of-Way Construction Projects - Agricultural Mitigation through the Stages of Project Planning, Construction/Restoration and Follow-Up Monitoring" and "Pipeline Construction-Trenching and Its Effects on Natural Subsurface Drainage, Impacts and Mitigation". These recommendations are incorporated into Millennium's ECS or the CAS.

In addition, Millennium would continue to work with NYSDA&M to make necessary adjustments to the pipeline route to take into account the unique soils and terrain crossed. These soils include those with long steep slopes on glacial till and/or shallow bedrock soils, those on moderate to steep slopes on lake-laid silty/clayey sediments, or those on mantles of glacial outwash underlain by lake-laid silty/clayey sediments. Millennium would file any route changes resulting from these consultations with the Secretary for the review and written approval of the Director of OPR before construction (see recommendation numbers 4 and 5 in section 7.2).

The NYSDA&M identified several other concerns in its review of the PDEIS. First, the NYSDA&M expects that as much as 20 percent of the land that Millennium classified as open land is actually used for agricultural purposes. Subtracting out the open land in Rockland and Westchester Counties, which is most probably open land because of the general rural-residential character of these counties, an additional 28 miles of agricultural land use could be affected by the pipeline crossing of the other counties. This would bring agricultural land to about 87.4 miles, or about 23 percent of the total land crossed by the pipeline. Millennium states that it would comply with our Plan, which requires topsoil segregation in annually cultivated or rotated agricultural land, hayfields, and other areas at the landowner's request. Therefore, any areas currently classified as open land that are actually used for agriculture under the definitions identified in Millennium's ECS and our Plan would be protected as agricultural land.

The NYSDA&M also commented that a 35-foot separation should be required in agricultural areas where the pipeline would be placed adjacent to Columbia's Line A-5 and Line A-5 is not abandoned (MPs 154.3 and 285.6). The NYSDA&M believes that future maintenance of the new pipeline, and Line A-5 if it were sold or operated for other purposes, may require digouts or replacements and that a 35-foot separation would allow these maintenance activities to be carried out without damage to the other pipeline. The NYSDA&M contends that, if Line A-5 is maintained in service, there would be insufficient space with the proposed 25-foot separation for full width topsoil segregation, spoil storage, and complete decompaction activities if either pipeline (and, in particular, the old pipeline) required maintenance during operation.

Millennium proposes to place its pipeline adjacent to either Columbia's Line A-5 or other Columbia pipelines for about 162.9 miles between Chautauqua and Delaware Counties (MPs 33.5 to 285.6). These areas include not only agricultural land, but wetlands, uplands, forest, and open land not used for agricultural (including pasture) purposes. About 50.6 miles of agricultural land and another 16.6 miles of open land (assuming about 20 percent of the open land is also used for agricultural purposes) would be crossed in this area for a total of about 67.2 miles of agricultural land (41 percent of the land crossed). From a design perspective, it would be difficult to consistently increase pipeline separation in agricultural land and then decrease pipeline separation in wetlands and other non-agricultural areas. To require a 35-foot separation in all areas where the new pipeline would be placed adjacent to Columbia's pipelines would increase construction right-of-way clearing requirements in forested areas and bring the construction work area closer to 59 residences. We believe that maintenance activities on the abandoned Line A-5, if it were put back in service, would not be significant and would be spread throughout the length of the pipeline. While the additional 10 feet of separation would provide additional working area, we believe that construction in agricultural land can be performed with a 25-foot separation between pipelines, and that the impact on other land uses resulting from a 35-foot separation would be unjustified considering the uncertainty of reactivation of the old pipeline, the need for maintenance on it, and the added impact this extra work space would cause. Further, pipelines have been routinely and safely constructed and operated with a 25-foot offset from active pipelines.

The NYSDA&M has recommended that the agricultural inspector would be responsible for altering the timetable of restoration if it was determined that overwintering soil stabilization methods are important to restoration success. Overwintering of soil would mean deferring final grading, decompaction, and planting until the next dry season rather than risk additional decompaction by doing such activities in wet soils. Overwintering also protects topsoil by allowing for trench settling to take place before final grading. Such methods are suitable for thin glacially-derived agricultural soils.

Section VI.A.1 of our Plan states that every effort should be made to complete final cleanup of an area (including final grading and installation of permanent erosion control structures) within 10 days after backfilling the trench in that area. If the schedule cannot be met, final cleanup must be completed as soon as possible. If the agricultural inspector determines that final cleanup should be delayed and that portions of the construction work area must be overwintered, then a plan should be prepared that identifies the right-of-way stabilization procedures that would be used and the areas where overwintering would occur. Therefore, we recommend that:

- **Millennium modify its ECP to include a contingency plan for overwintering agricultural areas and file it for review and written approval of the Director of OPR before construction. If the agriculture inspector directs Millennium to delay final cleanup, Millennium should identify these locations by milepost and file a request with the Secretary for review and written approval by the Director of OPR before implementing the overwintering plan.**

The NYSDA&M's other comments concerned Millennium's ECS and generally focused on additional clarification of specific sections of the ECS in sections II., Access Roads; III.E., Soil Decompaction; III.H., Monitoring; and figure 5, Interceptor Diversions, and figure 12, Trenchline Barriers and Breakers. Most of these comments are related to clarification of terms and procedures and many are editorial in nature. Therefore, we recommend that:

- **Millennium continue consultations with the NYSDA&M regarding specialized construction procedures in agricultural areas that should be incorporated into the ECS. The finalized ECS should be filed with the Secretary, before construction, for review and written approval of the Director of OPR.**

We note that there is a slight potential for soil chemistry to be adversely modified if large amounts of wood chips are spread on the right-of-way. This can alter the soil's carbon/nitrogen ratio and significantly slow revegetation. Millennium indicates that up to 2 inches of wood chips may be spread over the construction work area (section II.C.1 of the ECS). In our Plan, we recommend that if wood chips are used as mulch an additional slow-release nitrogen be added to the right-of-way to minimize the effect on the soil's carbon/nitrogen ratio (section V.F.3.d of the Plan). Millennium proposes to add 12 to 15 pounds of nitrogen (at least 50 percent of which would be slow release) per ton of chips to aid in revegetation. In accordance with its ECS and our Plan, revegetation would be considered successful only if perennial non-nuisance vegetation is similar in density to adjacent undisturbed land.

We also received a number of comments on the "black dirt" area between approximate MPs 350.0 and 354.0 in Orange County. This area has an extremely high water table with thick organic deposits that can be over 30 feet deep before reaching a distinct parent material. These soils are especially vulnerable because they have multiple-surface horizons that need to be carefully segregated, and because they are susceptible to subsidence and rapid decomposition when disturbed. These soils are used for a variety of vegetable crops in fields that contain precise contours that drain into drainage channels. Millennium has incorporated line change suggested by landowners, away from the existing Columbia pipeline to minimize impact on these fields. In addition, in response to landowner's recommendations, Millennium proposes to complete construction in October/November 1999 and restoration in April/May 2000, and would use a specialized crew to construct in this area. Millennium completed soil surveys in the black dirt area in March 1999 and proposes to file site-specific plans, including agricultural mitigation and typical ditch crossing plans, in mid-June 1999.

5.2.3 Aboveground Facilities

None of the three proposed measuring facilities would affect prime farmland soil. The Wagoner Station would require a 0.5 acre forested area adjacent to the existing Milford Compressor Station. The soils at the Wagoner Station site include the extremely stony Wurtsboro-Swartswood-Oquaga soil association. The Ramapo Station would be constructed on the site of an existing metering station, which would be removed. The Mount Vernon Station would be constructed on a 200-foot by 200-foot site in the parking lot of a property in Mount Vernon.

5.3 WATER RESOURCES

5.3.1 Groundwater

5.3.1.1 General Construction and Operational Impact

Construction activities associated with the proposed project could result in impact on groundwater resources. However, most of the potential impact would be avoided or minimized by the use of both standard and specialized construction techniques.

Shallow aquifers could experience minor impact from changes in overland water flow and recharge caused by clearing and grading in the construction areas along the proposed alignment. Enhanced water infiltration provided by a well vegetated cover would be temporarily reduced until the area is revegetated. Near surface soil compaction caused by the weight of heavy construction equipment could also reduce available pore space to transmit water to the subsurface. This impact would be short-term and would not be expected to significantly alter the groundwater resources because the construction right-of-way, in general, is a small portion of the total groundwater recharge area.

Trench dewatering may be required in areas where the proposed construction intersects groundwater. Dewatering activities may affect groundwater by decreasing water levels in the immediate area of the dewatering pumps or trenches or increasing water levels in the area where the pumped water is discharged. Because construction activities at a specific location are of relatively short duration, associated dewatering would only be a temporary activity with minimal impact. Millennium's ESC and our Procedures require that all water produced from dewatering operations be discharged into well-vegetated upland areas or into containment structures. To promote recharge to the affected aquifer via infiltration or runoff to surface water bodies, all discharges should be within the same hydrogeologic regime or sub-basin from where the dewatering originated. Use of these guidelines would result in minimal impact on the aquifer from dewatering activities.

Grade and trench blasting would be required where bedrock is exposed or less than six feet below the ground surface. Use of appropriate blasting procedures can minimize ground motion. This would then lessen the possibility of disrupting existing confining layers, creating new fracture openings or reducing or sealing existing fractures that would alter groundwater flow characteristics. Millennium would require its contractors to use procedures that would ensure that air blast and ground vibration limits are set at thresholds below which blasting damage is unlikely to occur. Millennium would also identify provisions for correcting problems that may arise, including compensation for assessed damages and making provisions for repair with local contractors. See section 5.3.2.2 for additional discussion.

Several landowners were concerned about changes in water quality or flow of their water wells as a result of construction activities. Where water supplies are shallow, there could be some temporary and localized decreases in groundwater quality and recharge rates because of grading and trenching (which may require blasting) or near surface compaction during clearing or grading. These would be expected to be short term interruptions only and should not affect long term groundwater quality and recharge rates. Millennium would conduct pre- and post-construction water quality and quantity testing of wells and springs used for drinking water purposes within 150 feet of the construction work area where approved by landowners. Testing would include pump inspection, flow rate quantification and collection of the following water quality parameters: coliform bacteriological cultures, total and dissolved lead, nitrates, nitrites, total and dissolved iron, total and dissolved manganese, sodium, pH, hardness, alkalinity and turbidity. Temporary fencing would also be erected around all private water supply wells identified within the construction work area to minimize any impacts. If a water well or spring is damaged as a result of Millennium's activities, Millennium would provide a temporary water source, and repair or replace the well.

Groundwater levels could also change in bedrock aquifers during construction if previously sealed fractures at the surface are exposed during trench excavation to create more flowpaths for aquifer recharge that may result in local flooding of adjoining properties. Generally, this is not a widespread problem and would be corrected during restoration when the trench is backfilled and the right-of-way restored to preconstruction contours. If the trench is not constructed with adequate trench barriers, new flowpaths could be created for groundwater migration along the pipeline trench. This would be addressed during construction by installation of trench barriers and breakers at specified intervals (a requirement of the ECS and the Plan) and by followup monitoring after construction.

Refueling of vehicles and storage of fuel, oils, lubricants or other related materials during the construction phase of the pipeline could create a potential contamination hazard to aquifers. Small, localized spills of these materials could be expected to occur during construction and could affect aquifer quality. Spills may also occur in gas/oil production fields if one of the collecting pipelines is ruptured during construction. Further contamination could continue to occur for a short time thereafter as precipitation passes through the affected soil and transports more material to the aquifer.

These types of impacts can be avoided or minimized by restricting vehicle refueling areas and maintenance and storage facility locations, and requiring immediate cleanup of any spills or leaks. Millennium has developed a SPCC Plan that outlines protective measures to minimize the possibility of a spill and the response measures to be followed in the event of a spill or leak (see section V of Millennium's ECS in appendix E1). These measures include designation of fuel and hazardous materials storage areas, containment requirements for fuel depots, minimum setback distances from natural resource areas for specified refueling and maintenance activities, clean up materials that need to be on site, and spill reporting procedures. In those aquifer protection districts that have specific requirements, Millennium would follow the district-specific procedures which may include prohibitions on refueling in specially designated areas, construction of silt fences and booms, or specification of the types of sorbent materials that should be available.

5.3.1.2 Site-Specific Impact

Millennium identified 15 major aquifer areas (including 7 NYSDEC recognized primary aquifers and 5 EPA designated sole source aquifers) that would be crossed for a total of 112.0 miles (see table 4.3.3-1). No specific requirements for crossing these aquifer areas have been identified to date. The pipeline would also cross three aquifer protection areas (Mayville, Lower Cassadaga Valley, and Chenango) and five public water supply watersheds, which may have more stringent site-specific protection requirements. Millennium has not completed consultation with each individual public water supply watershed district to identify local requirements. However, within each public supply watershed, Millennium would implement its SPCC Plan, as well as any local spill prevention and control plan, and would ensure that sorbents would be available in all vehicles working within the watershed. In addition, silt fence or booms would be installed around refueling area fences, and refueling would be restricted to the specified extra work areas in the watersheds listed below:

Ripley Public Water Supply Watershed, Ripley (MPs 37.7 to 39.9): Noble Road/Belson Road (approximate MP 37.7), Parker Road (approximate MP 39.0), and Douglas Road (approximate MP 39.8);

Westfield Public Water Supply Watershed, Westfield (MPs 41.7 to 43.6): Sherman Road (approximate MP 41.8), Ogden Road (approximate MP 43.4), and Bloomer Road (approximate MP 44.8);

- We-Wah Lake Watershed, Tuxedo (MPs 368.2 to 369.3): Intersection of Route 17 and Sterling Road (approximate MP 369.3);

New Croton Reservoir Watershed, Cortlandt, Yorktown, and New Castle (MPs 396.6 to 396.7): Quaker Bridge Road (approximate MP 396.3) and State Route 100 (approximate MP 399.7); and

- Grassy Sprain Reservoir Watershed, Yonkers (MPs 412.4 to 417.9): Dobbs Ferry Road (approximate MP 412.2) and Tuckahoe Road (approximate MP 418.6).

We reviewed Millennium's SPCC Plan and proposed mitigation and believe it does not adequately address certain issues within the aquifer protection areas and public water supply watersheds. Therefore, to ensure that aquifer protection areas are identified and would be adequately protected during construction, we recommend that:

- **Millennium file with the Secretary, before construction, copies of all correspondence with affected aquifer protection districts, including any specific mitigation measures that Millennium (in consultation with the district) would implement during construction.**

In addition, we recommend that

- **Millennium expand its SPCC Plan to specifically include the following:**

  a. containment dikes should have capacity for at least 100 percent of the maximum storage volume;

  b. refueling areas should be located hydraulically down gradient and outside of aquifer protection areas, wherever possible, and if located within an aquifer protection area, the refueling area should be lined;

  c. all equipment should be inspected daily for leaks before work within an aquifer protection area;

  d. all vehicles working within aquifer protection areas and public water supply watersheds shall have sorbents to cleanup spills that might occur;

e. **a listing of specific water supply, municipal, or state officials to be contacted in the event of a reportable spill; and**

f. **a listing of the requirements of local or state officials concerning construction in aquifer protection areas and public water supply watersheds.**

Based on consultations with landowners, Millennium identified 235 groundwater wells on properties crossed by the construction work area (see table 4.3.1-2). These are shown on the construction alignment sheets and their exact location in relation to the construction work area would be verified during easement acquisition before construction. In addition to these wells, Millennium states that any residential or agricultural water supply identified within 150 feet of the construction work area, which could be potentially affected by construction activities, would be subject to the same protective measures identified in the preceding section. However, some residential water supplies in the western part of New York are sited within perched aquifer systems. Penetration of the underlying aquiclude materials (low permeability materials that create the perched water conditions) would promote drainage of the perched water to deeper materials (overburden or bedrock) and potentially reduce well yields. Therefore, we recommend that:

- **Millennium file with the Secretary the location by milepost of all drinking water wells and springs within 150 feet of the construction work area and their distance from the construction work area, before construction. In addition, Millennium should specify which wells would be within perched water systems.**

If blasting is necessary in the vicinity of any agricultural or potable water supplies, Millennium would conduct pre-blast well sampling within 150 feet of the construction area and post blast sampling if requested by the owner. In the unlikely event that blasting activities temporarily or permanently impair water quality or yield, Millennium would provide a temporary water source, and repair, replace, or compensate the landowner. However, to insure that all issues relating to potential impact on water wells would be identified and addressed, we recommend that:

- **Millennium include in its weekly construction progress reports any complaints concerning water supply yield or quality and how each was resolved. Within 30 days of placing the facilities in service, Millennium should file a summary report identifying all potable water supply systems damaged by construction and how they were repaired.**

During its review of the project, the NYSDA&M identified an area in western Cattaraugus County between MPs 74.0 and 77.7 where the pipeline would cross several properties owned by Amish farmers. The affected parcels are on the south side of Seager Hill Road, between State Route 241 and County Route 40. According to the NYSDA&M, the natural lateral drainage across the subsoil horizons and shallow, impermeable bedrock result in shallow springs upon which the Amish generally depend for water supplies. The NYSDA&M believes that pipeline construction may alter these natural spring drainage pathways and affect the natural water source/supply on some Amish farms.

The NYSDA&M recommended six measures to develop site-specific information and mitigation plans for construction activities on the affected Amish farms. These measures include: continued consultation to determine the need to supplement individual water supplies during construction; development of an inventory of specific water systems that would be crossed by the pipeline; development of site-specific plans for the re-establishment of water supplies; consideration of minor route variations if vulnerable water sources are identified; finalization of restoration plans following review of actual construction disturbances; and monitoring the re-established farm water source/supply locations to ensure continued yields.

Millennium has committed to identifying water wells and springs located within 150 feet of the construction work area, and to repair any systems damaged by construction. In addition, Millennium would work with landowners to identify and protect specific resources on affected parcels. We have also recommended that Millennium provide a final listing of drinking water wells and springs within 150 feet of the construction work area, and that it include in its weekly construction progress reports any complaints concerning water well yield or quality and how each was resolved. Therefore, we believe that the NYSDA&M's concerns would be addressed on a project-wide basis and that the measures discussed above would be adequate to protect water supply systems on the Amish farms located between MPs 74.0 and 77.7.

5.3.2 Surface Water

5.3.2.1 General Construction and Operational Impact

Pipeline construction and hydrostatic testing could affect surface waters in a variety of ways. Clearing and grading of stream banks, blasting, in-stream trenching, trench dewatering, and backfilling could result in modification of aquatic habitat, increased sedimentation, turbidity, decreased dissolved oxygen concentrations, stream warming, releases of chemical and nutrient pollutants from sediments, and introduction of chemical contamination, such as fuel and lubricants.

The greatest potential impacts on surface waters would result from suspension of sediments caused by in-stream construction and by erosion of cleared stream banks and right-of-way. The extent of the impact would depend on sediment loads, stream velocity, turbulence, stream bank composition, and sediment particle size. These factors would determine the density and downstream extent of the turbid plume of sediment. Turbidity resulting from suspension of sediments due to in-stream construction or erosion of cleared right-of-way areas would reduce light penetration and the corresponding photosynthetic oxygen production. Re-suspension of deposited organic material and inorganic sediments would cause an increase in biological and chemical intake of oxygen, also resulting in a decrease of dissolved oxygen.

Clearing and grading of the stream banks would expose large areas of soil to erosional forces and would reduce riparian vegetation along the cleared section of the stream. The use of heavy equipment for construction would cause compaction of near-surface soils, an effect that could result in increased runoff into waterbodies. The increased runoff could erode stream banks, resulting in increased turbidity levels and sedimentation rates of the receiving waterbody. Impact on water temperatures would be expected to be minimal because of the limited length of stream bank canopy that would be cleared for the pipeline crossing. See section 5.3.2.3 for recommendations.

Refueling of vehicles and storage of fuel, oil, or other fluids near surface waters may create a potential for contamination due to accidental release. If a spill were to occur, immediate downstream users of the water would experience a degradation in water quality. Acute and chronic toxic effects on aquatic organisms could result from such a spill. Similar adverse effects on water quality could result from the re-suspension of pollutants from previously contaminated sediments during in-stream excavation activities (Macek et al., 1977). The amount of contamination released from resuspended sediments would depend on the existing concentration and on the sorptive capacity of the surrounding sediments. The potential for spills would be reduced by implementation of the required SPCC Plan (see section 5.3.1.1).

Millennium would verify pipeline integrity by hydrostatic testing, which is conducted by pressurizing the pipeline with water and checking for pressure losses resulting from leakage. About 126,920,000 gallons of water would be needed for hydrostatic testing. Withdrawal of test water from streams and rivers could temporarily affect downstream users and aquatic organisms (primarily fish) if the diversion constituted a large percentage of the source's total flow. Impacts could include temporary disruption of surface water supplies, temporary loss of habitat for aquatic species, increased water temperatures, depletion of dissolved oxygen levels, and temporary interruption of spawning, depending on time of withdrawal and current downstream users. In general, these impacts would be minimized by obtaining hydrostatic test water from waterbodies with sufficient flow to supply required test volumes without significantly affecting downstream flow. Impacts on spawning would further be avoided by performing hydrostatic testing during non-spawning periods (July 1 through September 3 or December 1 through March 3).

Potential impacts resulting from the discharge of hydrostatic test waters into streams and upland vegetated areas would be generally limited to erosion of soils and some subsequent degradation of water quality from increased turbidity and sedimentation. High velocity flows could cause erosion of the stream banks and stream bottom, resulting in temporary release of sediment. Continued erosion of the discharge area could occur if the discharge area is not properly stabilized with erosion control devices. Such erosion would be minimized by the use of energy dissipation devices, control of discharge velocity, and proper location of water discharge following testing. A listing of Millennium's proposed hydrostatic test water sources and discharge locations is provided in section 5.3.2.3.

5.3.2.2 Waterbody Construction and Mitigation Procedures

In response to concerns raised by Federal, state, and local agencies regarding the potential environmental impact of construction of pipeline projects in general, we developed our Procedures (see appendix E2 in appendix E) to provide a minimum level of protection for surface waters affected by pipeline projects. Applicable waterbodies include any streams or rivers with perceptible flow at the time of crossing and other permanent waterbodies, such as ponds and lakes. During development of the Procedures, we evaluated the effectiveness of various crossing methods (including open-cut and dry crossing methods) in mitigating potential impact on surface waters. The Procedures specify construction windows, in-stream construction duration constraints, sediment control procedures, and various fluming requirements to minimize potential impact from construction while providing an appropriate level of protection for a range of waterbody types. Waterbodies classified by the state as sensitive, high quality, or of exceptional value because of the presence of rare species, scenic qualities, recreational values, or important fisheries may require additional mitigation. Some of the more important aspects of the Procedures are summarized below:

> Minor waterbodies (less than or equal to 10 feet wide) supporting coldwater and significant warmwater fisheries would be crossed using a "dry crossing" or flume technique. A dry crossing involves placement of sand bags or other suitable structures in the waterbody channel to funnel stream flow into a flume pipe and past the work area. Trenching is conducted in a dry streambed under the flume pipe, thereby reducing the volume of sediment available for transport. In-stream construction work (except blasting) should be completed within 24 hours.
>
> Intermediate waterbodies (greater than 10 feet wide and less than or equal to 100 feet wide) would be crossed using either a dry crossing or a "wet crossing" (e.g., open-cut trenching) technique in which pipeline installation would be conducted in the water. If a

wet crossing is used, in-stream construction work beginning with trenching should be completed within 48 hours unless blasting is required.

Detailed, site-specific construction procedures for crossing each major waterbody (greater than 100 feet wide) would be developed and filed with the Secretary.

Sediment barriers would be installed and maintained on stream banks immediately after initial ground disturbance adjacent to all waterbody crossings.

- All construction equipment (except that used by clearing crews) would be required to cross all minor waterbodies with a state-designated fishery classification, and all intermediate waterbodies, on one of three types of temporary bridge: equipment pads and culvert(s), clean rockfill and culvert(s), or a flexi-float or portable bridge.

- All stream banks would be stabilized and temporary sediment barriers would be installed immediately or, if stream bank soils are saturated, within 24 hours of completing the waterbody crossing. Sediment barriers would be maintained at all stream banks until revegetation of the right-of-way has been judged successful.

We believe that implementation of Millennium's ECS, which incorporates our Procedures, specifically with regard to construction time windows, erosion control, stream bank stabilization, revegetation, and hydrostatic testing, would minimize impacts on waterbodies that would be crossed by the pipeline. However, because the water quality of surface waters, including surface water discharges and the dredging and filling of waters of the U.S., is regulated by the COE, EPA, and NYSDEC, further water quality protection measures may be required by those agencies. To construct and operate the proposed facilities, Millennium would obtain all applicable permits and comply with the requirements of these permits. These requirements may include site-specific waterbody construction plans or analysis of water samples for various water quality parameters after hydrostatic testing and before discharge. Section 2.7 contains a more detailed discussion of regulatory requirements for this project. Section 5.3.2.3 discusses additional mitigation for site-specific waterbody crossings.

5.3.2.3 Site Specific Impact

The Millennium Pipeline Project would cross Lake Erie and a total of 487 waterbodies, including 295 perennial waterbodies and 19 major waterbodies (e.g., rivers, creeks, and ponds that are over 100 feet at the crossing location). Table F1 in appendix F identifies each perennial and intermittent waterbody crossing and the proposed crossing method for each waterbody. Millennium proposes to cross 265 waterbodies (54 percent of all waterbodies) using dry crossing techniques (e.g. directional drill, horizontal bore, coffer dam, or dry ditch). Of these, 114 are intermittent streams that would be open cut if there is no perceptible flow at the time of crossing. Of the 295 perennial waterbodies that would be crossed, 149 waterbodies (51 percent) would be crossed using dry crossing techniques. Of the 146 perennial streams that would be open cut, 10 streams are less than 10 feet wide and would be crossed in 24 hours, and 119 streams are between 11 and 100 feet wide and would be crossed in 48 hours in accordance with our Procedures and Millennium's ECS. A summary of the crossing methods by stream type is provided in table 5.3.2.3-1. See section 5.3.3 for discussion of the Lake Erie crossing and section 5.3.4 for discussion of the Hudson River crossing.

TABLE 5.3.2.3-1

Summary of Proposed Waterbody Crossing Techniques

	Intermittent	Perennial	Total
Minor waterbodies (less than or equal to 10 feet wide)			
Dry ditch	0	93	93
Dry ditch if flowing; open cut if no flow	69	0	69
Open cut	53	10	63
Subtotal	**122**	**103**	**225**
Intermediate waterbodies (11 to 100 feet wide)			
Directional drill (Ramapo River)	0	1	1
Coffer dam (Neversink River - 2 crossings)	0	2	2
Dry ditch	2	51	53
Dry ditch if flowing; open cut if no flow	45	0	45
Open cut	23	119	142
Subtotal	**70**	**173**	**243**
Major waterbodies (over 100 feet wide) a/			
Directional drill (Chenango River)	0	1	1
Horizontal bore (Pochuk Creek)	0	1	1
Open cut	0	17	17
Subtotal	**0**	**19**	**19**
All waterbodies			
Directional drill	0	2	2
Horizontal bore	0	1	1
Coffer dam	0	2	2
Dry ditch	2	144	146
Dry ditch if flowing; open cut if no flow	114	0	114
Open cut	76	146	222
TOTAL	192	295	487

a/ Not including the Lake Erie crossing.

Millennium proposes to abandon the existing pipeline in place at waterbody crossings between MPs 37.2 and 285.6, except for 26 waterbodies where the existing pipeline would be removed (see comment C in table F1 in appendix F). However, the existing pipeline also would be removed in locations where it is exposed during trenching.

The existing pipeline would be removed at all waterbody crossings between MPs 285.6 and 376.4, except for the East Branch Delaware and Ramapo Rivers (MPs 287.0 and 287.6, respectively) where the existing pipeline would be abandoned in place. At all locations where the existing pipeline would be removed, removal of the old pipeline and installation of the new pipeline would be within the specified timing windows.

Millennium proposes to use in-stream sediment filter devices (SEDIMAT™ or their equivalent) and turbidity curtains to minimize downstream sedimentation at selected waterbodies (see note A in table F1 in appendix F). The SEDIMAT™ is a flat 4 foot by 10 foot pad that is laid directly in the streambed downstream of the area that would be disturbed. In 1992, it was tested at eight different streams in central and western New York. Seven of the sites were disturbed for pipeline installations; the eighth was disturbed by extensive hand shoveling. Stream widths varied from 10 to 75 feet, stream depth between 6 to 24 inches, and water velocity from 0.8 to 3.3 feet per second. Before construction, the average percent of sediment fines in the streambed was 12.2 percent just downstream of the crossing site. After construction, it rose slightly to 14.7 percent. This would be within sediment levels conducive to trout reproduction (egg survival). Where the mats were not used, the average percent of sediment fines rose from 11.5 to 24 percent.

The turbidity curtain is essentially a floating silt fence that filters or minimizes the amount of silt migration from construction activities within the streambed. However, use of either the SEDIMAT™ or the turbidity curtain has limitations. Although an individual SEDIMAT™ can trap and remove between 500 and 1,000 pounds of sediment, some silts tend to settle out on top of the mats requiring care in their removal to avoid displacing the silt. Removal of turbidity curtains often results in the displacement of the trapped sediments and short-term downstream turbidity. Millennium states that Columbia successfully used tubidity curtains and oil sorbent booms to minimize downstream visible plumes during trenching and backfilling in Owego Creek for a pipeline replacement.

In its comments on the project, the NYSDEC recommended that all streams be crossed using dry-crossing construction techniques. The COE had similar concerns and suggested that all waterbodies be investigated for the use of a directionally drilled crossing (see additional discussion in the following section on Horizontal Directional Drill Construction Technique). Dry crossings have several advantages over wet crossings, the most important of which is limited sediment release into the waterbody during trenching and installation of the pipe. In appropriate situations, dry crossings can be completed successfully with few downstream impacts. However, impacts can be prolonged in attempting to construct and maintain a dry crossing, with the most frequent problem being the maintenance of the dam to prevent failure or leaking. Loss of either the dam or the flume, or continued dam leaking, would result in the same or greater impact on the waterbody as an open-cut crossing. Table F3 in appendix F is an excerpt from a report prepared by the Canadian Pipeline Water Crossing Committee on the advantages and disadvantages of different waterbody crossing construction techniques (Watercourse Crossing Guidelines, 1998). It is based on observations of numerous waterbody crossings and indicates that each crossing technique has limitations and that no one crossing technique works for all situations.

Based on current pipeline construction experience, we believe that the decision to use dry crossing techniques should be based on two primary factors. First, if a waterbody has unique or sensitive aquatic resources or contributes to a public drinking water supply, it should be considered a candidate for using dry crossing techniques. An already degraded waterbody, however, may be relatively unaffected by in-stream construction. Second, some waterbodies possess physical characteristics that would prevent the use of dry crossing construction techniques. These characteristics may include high water flow volumes, impenetrable or unstable substrates, unsuitable stream bank conditions, stream width or depth, or numerous other physical attributes. It may be feasible to use dry crossing techniques at waterbodies that are between 10 and 30 feet wide, however, this presents greater technical challenges than crossings that are 10 feet wide or less. Use of dry crossing techniques at waterbodies that are over 30 feet wide at the crossing present even greater difficulty. Fifty-seven of the proposed intermediate perennial waterbody crossings are between 30 and 100 feet wide.

However, we concur that specific streams with appropriate topographic features and high value, quality, or significance should be crossed using dry crossing techniques. Millennium has not yet received written authorization from the appropriate state regulatory agencies regarding its proposed stream crossing techniques and states that it intends to work with the state in determining the most appropriate crossing technique for each waterbody. Therefore, we recommend that:

- **Before construction, Millennium file with the Secretary, for review and written approval by the Director of OPR, an update of its proposed construction method for**

Major Waterbody Crossings

The pipeline would cross 20 major waterbodies (including Lake Erie [32.9 miles], the Hudson River [2.2 miles], and 2 ponds) over 100 feet wide at the crossing location. Table 5.3.2.3-2 identifies each of these major waterbodies and the proposed construction crossing method. Millennium has filed site-specific open-cut crossing plans for 17 major waterbody crossings that would be open-cut. See sections 5.3.3 and 5.3.4 for discussion of the crossings of Lake Erie and Hudson River, respectively. See the following section, Horizontal Directional Drilling Technique, for further discussion of the use of directional drilling for the major waterbodies.

The Millennium Pipeline Project would be within the Pittsburgh, Pennsylvania, and Buffalo and New York City, New York COE Districts. The COE has determined that the pipeline would cross navigable waterways and that the project is subject to Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act. Lake Erie, the West and East Branches Delaware River, and the Hudson River are considered navigable waterbodies by the COE. Impact on navigation in Lake Erie and the Hudson River would not be significant since only a short segment of the waterbody would be affected at any one time and navigation could proceed around the construction activities. Millennium states that construction across the East Branch Delaware River (MP 287.0) would be limited to 4 days (2 days to excavate the trench, 1 day to install the pipeline, and 1 day to backfill the trench). Construction across the West Branch Delaware River (MP 276.0) would be completed in the same or less time, given its narrower width at the crossing location. This would limit the duration of impacts on navigation.

Horizontal Directional Drill Construction Technique

Millennium studied the feasibility of directionally drilling eleven waterbodies: Olean Creek, the Genesee, Cohocton, Chenango, Susquehanna, West Branch Delaware, East Branch Delaware, Mongaup, Wallkill, and Ramapo Rivers, and Teatown Lake. Except for the Wallkill (MP 350.7) and Ramapo (MP 370.0) Rivers, all of these crossings would be major waterbody crossings. Although Millennium originally proposed to directionally drill three of the rivers (the Chenango, West Branch Delaware, and Ramapo Rivers), borings completed in late 1998 indicate that only the Chenango and Ramapo Rivers are considered feasible, although problematic, for a directional drill.

The preliminary findings indicated that four crossings (Olean Creek, East Branch of Delaware River, Mongaup River, and Teatown Lake) were infeasible due to the geology at each crossing location. At Olean Creek (MP 111.2), East Branch Delaware River (MP 287.0) and Teatown Lake (MP 397.1), geology was determined from visual review of the surface that indicated near-surface solid rock that would impede the use of horizontal drilling techniques for the proposed crossings. At the Mongaup River (MP 330.0), the surface area is composed of many boulders that would make it unsuitable for drilling. Millennium determined that the open-cut crossing method would be better suited for these crossings since the presence of rock would not significantly affect an open-cut crossing. Millennium has not proposed any additional feasibility testing for directional drilling at these sites.

Millennium initially considered that directional drilling of the West Branch Delaware River (MP 276.0) would be feasible. Subsequent soil borings on the west bank of the river identified subsurface boulders which Millennium determined would preclude the possibility of a successful directional drill.

TABLE 5.3.2.3-2

Major Waterbody Crossings

County/ Milepost	Waterbody	Crossing Width (ft)	Proposed Crossing Method	Water Quality Classification a/
0.0	Lake Erie b/	173, 976 (32.9 mi)	Jet sled/barge; directional drill the shoreline	CWF (PA) A (NY)
Chatauqua				
41.0	Tributary Lake Erie b/	160	Open cut c/	C
60.3	Tributary Cassadaga Creek b/	113	Open cut c/	C
Cattaraugus				
111.2	Olean Creek b/	180	Open cut, June 1 to November 30 c/	A
Allegany				
137.3	Genesee River b/	130	Open cut, June 1-September 15 c/	A(T)
Steuben				
181.4	Cohocton River b/	203	Open cut, June 1-September 15 c/	C
Tioga				
230.3	Owego Creek b/	122	Open cut, June 1-September 15 c/	C(T)
235.2	Pond d/	140	Open cut	C
Broome				
249.8	Chenango River b/	275	Directional drill, if feasible	B
263.2	Susquehanna River b/	369	Open cut, June 1-November 30 c/	B
Delaware				
276.0	West Branch Delaware River	270	Open cut, June 1-September 15	B(T)
287.0	East Branch Delaware River b/	512	Open cut, June 1-September 15 c/	C
Sullivan				
307.0	Callicoon Creek b/	190	Open cut, June 1-September 15 c/	C(T)
330.0	Mongaup River (Rio Reservoir) b/	675	Open cut, Fall-December 1 c/	B(T)
Orange				
352.4	Pochuck Creek b/	113	Horizontal bore	C
357.0	Wheeler Creek b/	345	Open cut, June 1-November 30 c/	D
Rockland				
387.5	Pond d/	485	Open cut	D
Rockland/Westchester				
387.9	Hudson River b/	11,850 (2.2 mi)	Open cut, November 1-January 31	SB
Westchester				
392.9	Furnace Brook Lake b/	620	Open cut, June 1-November 30 c/	B
397.1	Teatown Lake b/	358	Open cut, June 1-November 30 c/	B

a/ See table F2 in appendix F for water quality and fishery classifications.
b/ Site-specific open-cut crossing plans have been prepared and filed.
c/ Waterbody would be excavated using backhoe or dragline (barge-mounted for Furnace Brook and Teatown Lakes). In-stream sediment filter devices would be installed downstream before construction begins. Construction would require about 2 days to excavate the trench, 1 day to install the pipe, and 1 day to backfill.
d/ Man-made pond with no specific concerns identified by the landowner for the crossing.

At the Susquehanna River (MP 263.2), the floodplains adjacent to the river are known to contain numerous archaeological resources. In its preliminary investigation, Millennium determined that a number of factors would preclude the use of a drilled crossing. First, the valley configuration is such that a directional drill would necessitate a steeply angled and abrupt approach from the west side and a gradual, long pullout on the east side. Millennium maintains that such an approach and pullout would impact unnecessarily the deeply buried archaeological deposits present in both floodplains. Second, archaeological sites to the east and west of the river are marked by stratified deposits ranging between 61 and 110 inches, but the extent of the cultural deposits has not been studied. Millennium plans to complete deep testing in April and May, with additional work scheduled for June and early July.

The COE commented that all waterbodies be considered for a directional drill and requested the estimated cost of trenching versus directional drilling for all waterbodies where a directional drill is not discounted for technical reasons. Millennium responded that a number of site-specific factors affect the viability of a directional drill. These include geology, topography, pipeline alignment at the crossing, the need for an adequate staging area for the drill rig and pipe string, and the surrounding built environment. In addition, this technique requires that there are no bends between the exit and entry holes. Based on these constraints, Millennium determined that of the 147 waterbodies that it proposes to open cut, a directional drill would be infeasible for 62 waterbodies (see table F4 in appendix F).

Because the pipe in a directional drill must be installed free of stress, Millennium stated that each drill would need to be a minimum of between 1,200 and 1,600 feet in length for a 36-inch-diameter pipe. The maximum length for a directional drill would be between 4,000 and 4,500 feet under ideal soil and construction staging conditions. Millennium stated that for a 36-inch-diameter pipe under less than ideal conditions, anything beyond 3,500 feet would be considered beyond the state of the art of the industry.

Millennium provided a preliminary cost comparison of an open cut versus a directional drill for each of the waterbodies that were not eliminated for a directional drill for technical reasons (see table 5.3.2.3-3). Millennium did not consider three other crossings (the Genesee, Cohocton, and Wallkill Rivers) to be feasible for directional drilling because of the excessive cost associated with this construction method. Open cut costs were estimated at $54,000 for the East Branch Delaware River, $130,000 for the Mongaup River, and $86,000 for Teatown Lake.

TABLE 5.3.2.3-3

Cost Comparison of an Open Cut versus a Directional Drill for the Genesee, Cohocton, Chenango, Susquehanna, West Branch Delaware, Wallkill and Ramapo Rivers

Waterbody	Open Cut Estimate	Drilled Estimate (good soils)	Ratio of Drill Cost (good soils) versus Open Cut Cost	Drilled Estimate (poor soils)	Ratio of Drill Cost (poor soils) versus Open Cut Cost
Genesee River	$ 148,000	$ 250,000	1.69	$ 500,000	3.38
Cohocton River	125,400	225,000	1.79	450,000	3.59
Chenango River	433,000	346,000	0.80	865,000	2.00
Susquehanna River	456,000	640,000	1.40	1,600,000	3.50
West Branch Delaware River	175,000	180,000	1.03	450,000	2.57
Wallkill River	194,000	250,000	1.29	500,000	2.58
Ramapo River	489,000	500,000	1.02	1,000,000	2.04

Millennium also provided a generic cost comparison of a conventional versus directional drill crossing by two separate drilling contractors (Michels Pipeline Construction, Inc. and Laney Directional Drilling through Henkle & McCoy). A conventional open-cut crossing would be about $105 per foot. A directional drill would be between $630 and $738 per foot drill under ideal soil conditions [3/] and $1,050 per foot under poor soil conditions [4/]. In addition, Millennium provided estimates from Michels Pipeline Construction, Inc. on specific waterbody crossings (see table 5.3.2.3-4). These costs were based on a single attempt to complete the crossing using a directional drill. Costs for a guaranteed directional drill would be higher. Millennium estimates that, because of the geology in the southern tier of New York, about half of the crossings would require two or more attempts to successfully complete the drill and that 15 percent of the crossings would ultimately need to be completed using conventional open cut crossing techniques. These costs were not included in the estimate.

TABLE 5.3.2.3-4

Cost Comparison of a Conventional versus a Directional Drill Waterbody Crossing at Selected Waterbodies

Waterbody	Approximate Milepost	Drill Length (feet)	Conventional Open Cut	Directional Drill	Additional Cost for Directional Drill
Genesee River	137.3	1,600	$ 171,121	$ 1,295,696	$ 1,124,575
Owego Creek	230.3	1,600	172,974	1,295,696	1,122,722
Susquehanna River	263.2	3,000	318,643	2,429,430	2,110,787
Neversink River	341.0	1,640	186,751	3,181,793	2,995,042

In our experience, a directional drill works well under the proper conditions. However, we have seen instances where an open cut was ultimately required after repeated attempts to complete the drill hole failed or the pipe could not be pulled completely through the hole. In some cases, the pipe could not be withdrawn and had to be abandoned in place. Although we have seen directional drills completed in less than ideal conditions, we have also seen instances where extensive excavation was required along the drill path to retrieve drilling equipment that became lodged in the drill hole, where more than one hole had to be drilled before the drill could be successfully completed, and where sink holes developed along the drill path. A directional drill does not work well in all situations and can result in additional environmental impact on land and in wetlands, specifically where extraordinary measures are required to compensate for poor soil conditions. Given the costs and the inherent problems with a directional drill, we believe that a directional drill should be considered and recommended where there are recognized environmental concerns, such as fisheries or water quality issues.

Based on these criteria, we believe that the Genesee, Cohocton, Susquehanna, Neversink, and Wallkill Rivers should be further evaluated for the feasibility of a directional drill. The Genesee and Susquehanna Rivers are high quality waters (Water Quality Classification A and B, respectively). In addition, the Genesee River is a state-listed designated study river, the Cohocton and Wallkill Rivers are listed on the NRI, and the Neversink River contains a population of the federally-endanged dwarf wedge mussel. Millennium proposes to complete further evaluation of the feasibility of directionally drilling the Genesee and Susquehanna Rivers and file the results in May 1999. We recommend that:

3/ Ideal conditions refer to conducive soils (sand, clay, or consolidated material) at the drill depth.

4/ Poor conditions refer to rock, gravel, and unconsolidated material at the drill depth.

- **Millennium conduct further evaluations by an independent drilling contractor on the feasibility of a directionally drilled crossing of the Genessee, Cohocton, Susquehanna, Neversink, and Wallkill Rivers (MPs 137.3, 181.4, 263.2, 341.0, and 350.7, respectively). Results of the geotechnical investigations should be filed with the Secretary before the close of the comment period on the DEIS.**

Directional Drill Contingency Plans

Generally, construction specifications for directional drill construction require that the quantity of excess drilling mud be minimized. Recirculation of the drilling fluid by removal of cuttings would minimize the volume of waste material generated during the drilling operation. Collected surface returns would be processed through a solids control system which would remove spoil from the mud allowing it to be re-used. Mechanical separation would be accomplished using shale shakers, distillers and desanders. In the drill area, storage containers (tanks) or excavated impoundments would be used for containment of drill cuttings and excess drilling mud for subsequent approved disposal.

Installing the pipeline by directional drilling would avoid direct impact on the waterbodies and the associated riparian systems. However, our experience has been that a directional drill can result in the uncontrolled releases of drilling mud into the waterbody or nearby areas through previously unidentified fractures in the material underlying the riverbed. According to the site-specific plans filed for each major waterbody, Millennium would install and maintain erosion control devices in accordance with our Procedures. The environmental inspector would be notified immediately of any uncontrolled releases of drilling mud and would be responsible for completing any required cleanup. A directional drill can also fail for various reasons including failure to complete the pilot hole (the hole opening for the pipe), inability to maintain a stable open hole, loss of the hole opening tool because it becomes lodged or twists off, inability to pull the pipe back through the hole, or loss of drill head which may encounter obstacles during drilling operation that push the drill out of alignment causing it to exit into the waterbody.

If geotechnical conditions are favorable, it is unlikely that a directional drill crossing would be abandoned in favor of a different crossing method unless the directional drill fails in process. However, for each waterbody where a directional drill would be attempted, we recommend that:

- **Millennium file with the Secretary a plan for the crossing of each waterbody if the directional drill is unsuccessful. This should be a site-specific plan that includes scaled drawings identifying all areas that would be disturbed by construction. Millennium should file this plan concurrent with its application to the COE for a permit to construct using this plan. The Director of OPR must review and approve this plan in writing before construction of the crossing.**

The COE noted that the Genesee River has a flood control berm at the crossing and that an open cut crossing plan should address restoration of the berm to preconstruction conditions. Therefore, we recommend that:

- **Millennium should consult with the COE and expand the site-specific crossing plan for the Genesee River (MP 137.3) to include construction and restoration mitigation measures to protect the integrity of the flood control berm. The revised plan and COE comments should be filed with the Secretary for review and written approval by the Director of OPR before construction.**

Public Water Supplies

The pipeline would cross four waterbodies within 3 miles of active public water intakes

Belson Creek at MP 38 (about 2.6 miles upstream of the supply intake for the Alford Reservoir);

Olean Creek at MP 111.2 (about 1.6 miles upstream of the supply intake for Olean);

Genesee River at MP 137.3 (about 0.3 mile downstream of the active primary intake and 1.5 miles upstream of the inactive secondary intake for Wellsville); and,

Indian Kill Tributary at MP 367.0 (about 0.2 miles upstream of the community water intake for Indian Kill).

Millennium proposes to open-cut three of these waterbodies, would install in-stream sediment filters, and would contact local water authorities one week before actual in-stream construction. Belson Creek would be crossed using dry construction techniques. Millennium has evaluated Olean Creek and is in the process of final evaluation of the Genesee River for directional drill. Geoarchaeological investigations indicate that conditions are not favorable for completion of a successful directional drill crossing at Olean Creek. Millennium will conduct detailed geomorphological and geoarchaeological investigations at the Genesee River in Spring 1999.

Millennium has proposed to cross Indian Kill Tributary using open-cut techniques. However, since Indian Kill Tributary is a minor stream (under 10 feet wide at the crossing location) located upstream of a public water supply intake, the use of a dry crossing technique would reduce the potential for a significant increase in turbidity associated with open-cut construction techniques. Therefore, we recommend that:

- **Millennium use dry-crossing construction techniques across Indian Kill Tributary (MP 367.0).**

The use of either dry-crossing or directional drilling techniques would eliminate most of the potential for increased turbidity associated with open-cut crossings. Since a directional drill is not feasible to cross Olean Creek, and if open-cut techniques must be used to cross the Genesee River, direct impact on surface water supplies would be limited to the 4 days required to construct across these waterbodies. These impacts would consist of an increase in suspended sediments, but probably at levels similar to those naturally occurring following significant storm events. Other temporary impacts associated with clearing and restoration activities would be minimized by installation and maintenance of erosion control devices in accordance with the ECS and our Procedures. These include provisions for refueling construction equipment at least 100 feet from all waterbodies and wetlands to reduce the potential for impact associated with spills of hazardous liquids. Millennium would also implement its SPCC Plan, which contains specific procedures to be implemented in the event of a spill or if refueling must be conducted less than 100 feet from any waterbody. Therefore, we believe impacts to water supplies would be minimal and temporary.

The pipeline would cross the abandoned New Croton Aqueduct at MP 398.4, parallel the Catskill Aqueduct at a minimum distance of about 210 feet for about 4,000 feet between MPs 399.7 and 401.6, and would cross the Catskill Aqueduct at about MP 418.8. Millennium consulted the NYCDEP regarding construction of the proposed pipeline. The NYCDEP expressed concern regarding Millennium's proposed separation distances between the pipeline and the aqueduct where the pipeline would parallel a "cut and cover" section of the aqueduct along the Con Edison right-of-way near Millwood, New York. Specifically, the NYCDEP's concern was that a failure of the pipeline could result in interruption of water supplied to New York City via the Catskill Aqueduct.

In response to NYCDEP's concerns, Millennium conducted a detailed survey of the proposed route where it would parallel the Catskill Aqueduct. Millennium determined that the proposed pipeline would at no point parallel the aqueduct at a distance of less than 200 feet (centerline to centerline). The minimum separation distance would be about 209 feet at one discrete point, and the distance between the pipeline and the aqueduct would generally exceed 250 feet in the Millwood area and 300 feet in all other locations for the length of the route that would parallel the "cut and cover" section of the aqueduct. In addition to the survey, Millennium commissioned a site-specific study of the area by two recognized experts on pipeline failure analysis. Their study concludes that, in light of the characteristics of the proposed pipeline, the aqueduct, and the geology of the area, the minimum separation distance of 209 feet where the pipeline parallels the aqueduct should ensure that there would be no damage to the aqueduct even in the very remote event that there were a pipeline rupture and explosion along this short portion of the route. Millennium proposes to avoid blasting within 150 feet of the crossing sites and would observe the 10-ton load limit specified by the NYCDEP. Millennium is currently developing, but has not yet completed development of site-specific crossing plans. Therefore, we recommend that:

- **Millennium file with the Secretary detailed crossing plans for the New Croton Aqueduct at MP 398.4 and the Catskill Aqueduct at MP 418.8. These should be site-specific plans that include scaled drawings identifying all areas that would be disturbed by construction. The Director of OPR must review and approve this plan in writing before construction of the crossing.**

Hydrostatic Testing

Millennium identified 37 waterbodies that would be used as source and/or discharge locations for hydrostatic test water (see table 5.3.2.3-5). Any other water used for hydrostatic testing of components of the pipeline would be obtained from local water companies or landowners. Millennium estimates that about 126,920,000 gallons of water would be required to test the pipeline.

Water would be withdrawn and discharged within the same watershed, except for water withdrawn from the Croton River (Hudson River watershed) that would be discharged into the Bronx River (Bronx River watershed). Millennium states that it would develop a plan to treat water before its release into a watershed different from the one from which it is withdrawn, if the NYSDEC determines that the water is contaminated with micro-organisms.

Millennium identified the Neversink River as a proposed source and discharge for hydrostatic test water. This river provides habitat for known populations of the federally endangered dwarf wedge mussel. In accordance with our Procedures, Millennium would be required to obtain written permission from appropriate Federal, state, and/or local permitting agencies to use this waterbody for hydrostatic test water. See additional discussion in section 5.6.3.

TABLE 5.3.2.3-5

Proposed Hydrostatic Test Water Source and Discharge Locations

County	Approximate Milepost	Waterbody	Source	Discharge a/	Source Volume (gallons) b/
Chautauqua	32.9	Lake Erie c/	Yes	Yes	26,760,000
	41.0	Tributary Lake Erie	No d/	Yes	0
	59.9	Cassadaga Creek	Yes	Yes	7,360,000
	69.0	Clear Creek	Yes	Yes	1,060,000
Cattaraugus	73.0	State Drainage Ditch	Yes	Yes	5,710,000
	94.7	Great Valley Creek	Yes	Yes	4,360,000
	111.2	Olean Creek	Yes	Yes	5,500,000
Allegany	132.1	Knight Creek	Yes	Yes	1,380,000
	137.3	Genesee River	Yes	Yes	7,390,000
Steuben	165.4	North Branch Tuscarora Creek	Yes	Yes	1,630,000
	171.5	Canisteo River	Yes	Yes	2,600,000
	181.4	Cohocton River e/	Yes	Yes	200,000
	182.1	Meads Creek e/	Yes	Yes	5,480,000
Chemung	202.9	Newtown Creek	Yes	Yes	3,170,000
	215.0	Cayuta Creek	Yes	Yes	3,480,000
Tioga	228.1	Catatonk Creek e/	Yes	Yes	580,000
	230.3	Owego Creek e/	Yes	Yes	2,730,000
Broome	240.7	Nanticoke Creek	Yes	Yes	2,390,000
	249.8	Chenango River	Yes	Yes	3,540,000
	263.2	Susquehanna River	Yes	Yes	3,390,000
Delaware	276.1	West Branch Delaware River	Yes	Yes	2,990,000
	287.4	East Branch Delaware River	Yes	Yes	3,120,000
Sullivan	299.3	Basket Creek	Yes	Yes	1,990,000
	306.8	Callicoon Creek	Yes	Yes	2,910,000
	317.9	Smith Mill Brook	Yes	Yes	3,200,000
	330.0	Mongaup Reservoir	Yes	Yes	2,830,000
Orange	340.8	Neversink River	Yes	Yes	1,700,000
	347.2	Rutgers Creek	Yes	Yes	920,000
	350.7	Wallkill River e/	Yes	Yes	440,000
	352.4	Pochuck Creek e/	Yes	Yes	4,560,000
	359.5	Tributary Wawayanda Creek	No f/	Yes	0
	366.8	Tributary Indian Kill Reservoir	No g/	Yes	0
	369.7	Ramapo River	Yes	Yes	4,680,000
Rockland	387.5	Minisceongo Creek e/	Yes	Yes	100,000
Rockland/Westchester	387.9	Hudson River e/	Yes	Yes	1,980,000
Westchester	395.4	Croton River	Yes	Yes	6,790,000
	421.2	Bronx River	No h/	Yes	0
		TOTAL			126,920,000

a/ Discharge location would be the final destination after upland filtering.
b/ Volumes listed are approximate and equate to the pipeline fill volume with no contingencies for cleaning/flushing water, possible hydrotest failure, or extra water to vent air. Section length does not correspond to hydrotest section lengths.
c/ Includes entire Lake Erie pipeline (93.6 miles).
d/ Source water would be withdrawn from Lake Erie.
e/ Volumes are interchangeable for rivers within $\pm$ 1 mile of each other.
f/ Source water would be withdrawn from Rutgers Creek, the Wallkill River, and/or Pochuck Creek.
g/ Source water would be withdrawn from the Ramapo River.
h/ Source water would be withdrawn from the Croton River.

In accordance with its ECS and our Procedures, Millennium would obtain written permission from appropriate state agencies before withdrawal from or discharge into state-designated high quality streams or public water supply streams. Test water would not be withdrawn from any source that could result in degradation of its state-designated water uses. In accordance with our Procedures, Millennium would screen all intake hoses, implement protective measures to minimize erosion during discharge of test-water, and would not introduce chemicals into hydrostatic test water. However, methanol may be injected into the pipe to evaporate excess water that may remain after discharge of hydrostatic test water. Millennium states that any excess methanol would be collected and disposed in accordance with applicable state and local regulations. No methanol would be discharged into state waters.

5.3.3 Lake Erie

Lake Erie would be crossed using conventional underwater construction by mechanical jetting and by directionally drilling at the shoreline. Since the proposed route would cross through the non-depositional Long Point-Erie sill for its entire length, it would generally avoid areas characterized by more heavily contaminated sediments. Generally, environmental concerns related to open trench construction are associated with direct trenching impacts, turbidity generation and siltation, and chemical releases from sediments. Sediment quality along the proposed route through Lake Erie is discussed in section 4.3.3.

The physical disruption of bottom habitat by mechanical jetting trench excavation would likely have a localized impact on aquatic communities on the surface of and within the substrate. The extent of disruption impact would depend on the type of bottom substrate, the extent of the disturbed area, resultant turbidity and sedimentation, and the timing of construction. The greatest impact would occur at the excavation site and its magnitude would decrease with distance from the trench as the impacts of turbidity and sedimentation lessen. Organisms living in and on the bottom along the centerline would suffer high mortality because of the forces of mechanical disruption. Less mobile organisms adjacent to the trench may suffer high mortality from burial under deposited sediments. Mobile organisms would likely move out of the area during construction, avoiding direct impact but may face competitive and predatory impacts in the temporary habitat. Further afield, but within the plume, organisms may experience a short period where respiration and feeding are impaired by the elevated suspended sediments, but not enough to cause measurable adverse affects.

Temporary increases in suspended solids would be expected as a result of in-lake construction activities. The time that the particles remain suspended depends on their settling velocities and water turbulence. The distance of travel by the sediments from the source to the point of deposition, depends on the current velocity. Colloidal and flocculated materials in particular would remain suspended and would travel further down current before resettlement. Van Arkel (1997) modelled the expected suspension and deposition attributable to jetting the trench across Lake Erie. The model predicted a plume with TSS concentrations greater than 1,000 mg/l would be generated and would cover an area of about 1,600 feet by 330 feet. This plume would follow construction across the lake. Concentrations would not be sustained at any location.

Previous studies have indicated that TSS concentrations greater than 10,000 mg/l must be sustained for more than 5 days to be lethal to zooplankton and clams. Similarly, short-term suspended sediment concentrations of 20,000 to 100,000 mg/l showed no lethal effect on fish species (Wallen, 1951). The estimates for plume length, width, and duration for a TSS concentration of 263 mg/l, the highest previously observed TSS concentration for Lake Erie (Great Lakes Laborabory, 1981), are provided in table 5.3.3-1. The duration of the plume represents the time required for the plume to disperse. Because the predicted turbidity levels would not be sustained at any location beyond about 9 hours, the impact would be temporary and minimal.

TABLE 5.3.3-1

Plume Length, Width, and Duration with a TSS Concentration of 263 mg/l in Lake Erie a/

Ambient Velocity	Maximum Length	Maximum Width	Plume Duration
Jet Sled Discharge at Bottom:			
0.16 ft/s	0.9 mi	260 ft	7 hours
0.03 ft/s	1,600 ft	500 ft	9 hours
Suction Hose Discharge at Surface:			
0.60 ft/s	1.6 mi	200 ft	4 hours
0.01 ft/s	2,600 ft	330 ft	7 hours

a/ Great Lakes Laboratory (1981) reported highest observed TSS concentration in Lake Erie. Higher concentrations may occur during storm events.

Source: Van Arkel, 1997.

Releases of high concentrations of organic and inorganic contaminants from sediments during trenching may lead to increased bioaccumulation, producing sublethal effects on growth and reproduction and thus, a decrease in biological productivity of less tolerant organisms. Based on the low concentrations of chemical parameters in the sediment (see section 4.3.3), the large dilution capacity of the project waters, and the transitionary nature of the jetting activities, only localized short-term degradation of water quality would be expected. Any chemical releases would be small and their effects would be localized and temporary, with rapid dispersion by mixing and sorption processes to ambient levels. Considering the short duration of exposure, the probability of any significant bioconcentration of contaminants by fish is low. Similarly, no net impact would likely result from contaminant resusupension on benthic macroinvertebrates since these organisms are in contact over their life span with the chemical constituents in the sediments (interstitial waters).

Temporary disruption of sportfishing, commercial traffic, boating and other recreational activities would be expected to occur due to the physical disturbance, noise and turbidity resulting from water-based construction activities. For example, construction would interfere with sportfishing and recreational boating by restricting access to portions of the project area for safety reasons. However, the impacts would be minimal as most of the lake would remain open for boat transit.

Another concern related to open trench construction would be the potential for pipeline damage from ice scour along the bottom of Lake Erie. Ice scour is a feature of seabeds where a trough is found in the seabed as a result of icebergs or pressure ridges [5/] that have touched, penetrated, and moved forward through the seabed. Because of the widespread occurrence of ice scour in most polar regions and off the east coast of Canada, this phenomenon has been subjected to intensive research to develop the appropriate design for oil and gas pipelines. National Fuel, in particular, commented extensively on the potential hazards of ice scour on the pipeline in Lake Erie.

5/ A pressure ridge is a refrozen or partially refrozen pile-up of ice blocks formed from floating ice sheets that are pushed against one another. A pressure ridge can develop in ice covered water where the ice buckles and overrides adjacent ice to the extent that the ridge formed by this process touches the seabed.

To address these concerns, C-CORE completed a report for TransCanada that focused on three primary objectives, which could affect the integrity of the pipeline in Lake Erie: 1) an evaluation of the risk of ice damage associated with scour events; 2) an assessment of the risk of damage from trawl doors, dropped objects, and anchors; and 3) recommendations for pipeline depth that would be required to meet safety criteria (C-CORE, 1998). C-CORE estimated that ice scour could be expected over about 75 percent of the pipeline route.

C-CORE used data from the original side scan sonar and other surveys of the pipeline route, data from the Ontario Hydro cable surveys conducted in 1980 and 1982, data from the USGS scour surveys conducted in the 1990s offshore of Ohio, and available information on ice, soil, and environmental conditions in Lake Erie. These data were used to develop models to measure the risk of pipeline damage from ice scour and took into consideration pipeline diameter and proposed design specifications for 3-inch concrete coating and a trench depth of 6.5 feet. The pipeline trench depth analysis was based on expected distributions of scour depth, width, and potential sub-scour deformation along the pipeline route; the effect of the scours and scouring effects on pipeline stresses; and the likely frequency with which gouging ice features would cross the pipeline. The entire pipeline route across Lake Erie was divided into 12 sections of approximately similar water depth, soil type, and ice conditions to account for varying rates and depths of gouging, and soil properties. A design scour depth with an annual probability of exceedance was then determined for each section. The model for the interaction between pressure ridges and the seabed included the effects of ice geometry, soil strength, scour geometry, and sub-scour deformations. A structural model was also developed, using the finite element method, to analyze the response of a buried pipeline subjected to an ice scour event. The C-CORE report concluded that:

> The 10-year design scour depth ranged between 1.3 and 3.3 feet, while the 100-year design scour depth ranged between 2.5 and 4.5 feet. A minimum trench depth of 7.3 feet is recommended near the landfalls in Canada and the U.S.
>
> A thick boundary of 1.5 feet would be required between the pipe crown and the 1 to 100-year scour base to satisfy the axial tensile strain criteria in hard soils. The boundary could be reduced to 8 inches in softer soils. Recommended trench depth ranged from 6.5 to 9.5 feet.
>
> A thick boundary of 3.3 feet would be required between the pipeline and the 1 to 10-year scour base to satisfy the effective stress criteria. In softer soils, the boundary could be reduced to 1.5 feet. Recommended trench depth ranged from 6.5 to 10 feet.
>
> The recommended depth of burial would satisfy seabed incursions associated with fishing activities (such as trawl board drag over the pipeline in Canadian waters). It was considered impossible to designate a practical depth for dropped objects. The risk for a dragged anchor to effect the pipeline is 1 in 180 years. The risk for an anchor to effect the pipeline is 1 in 19,700 years.

National Fuel filed two technical reports that were prepared by Intec Engineering, Inc. (1998a, 1998b) for BP Exploration Alaska, Inc. The reports were prepared to address the potential for ice scour damage on 10.7-inch-diameter pipelines that are proposed for the Northstar Development Project. This project is located about 6 miles offshore of Point Skorkersen in the Beaufort Sea, off of northeast Alaska. The reports indicate that this area has relatively mild ice scour that is similar to that in Lake Erie. National Fuel stated that Northstar proposes 7 to 9 feet of cover over its pipelines and would mechanically backfill the trench to protect its pipelines from potential ice scour. By contrast, Millennium proposes a minimum of 3.3 feet of cover and would allow the trench to backfill naturally from localized slumping of the trench sediment immediately behind the jetting operation.

However, Millennium states that the directional drill of the landfall would involve drilling a pilot hole from the shore to exposed bedrock about 2,620 feet offshore at a water depth of about 25 feet. The exposed bedrock continues for another 1,560 feet offshore before being overlain by very coarse till material (boulders and gravel). Exposed bedrock and coarse till material continues for another 2,870 feet before becoming fine bottom substrate (silt and clay) at a water depth of about 56 feet. Millennium has not explained how it would attain the trench depths in this area and in deeper water to insure adequate cover to reduce the risk of damage that might be caused by ice scour.

While we believe the conclusions of the C-CORE report are reasonable since they were based on site-specific data from Lake Erie, we also believe that all prudent measures should be implemented to avoid the risk of damage to the pipeline from ice scour, including greater trench depth and mechanical backfilling if feasible. We have asked the COE to assist us in evaluating the ice scour studies and identifying appropriate pipeline design and construction procedures. Millennium has not yet indicated if it would incorporate the C-CORE or any other recommendations into its design. Therefore, we recommend that:

- **Before construction, Millennium file with the Secretary for review and written approval by the Director of OPR, the finalized plans for the Lake Erie crossing. The plan should include final trench depth by segment, how these depths would be verified and maintained during pipe installation and backfilling, and copies of all correspondence on the plan from the COE and other appropriate state agencies.**

Millennium proposes to directionally drill the Lake Erie landfall for a number of environmental reasons including bluff instability, the high energy of the near shore zone that would result in difficult restoration, greater ice scour potential in the near shore that increases the risk of pipeline damage, and direct impacts from trenching which include turbidity and siltation on the sensitive biological resources in the near shore. The pipeline would be directionally drilled from onshore and would exit in waters 20 to 30 feet deep in Lake Erie.

Lake Erie is classified as a coldwater fishery in Pennsylvania and a Class A (high quality) waterbody in New York. The NYSDEC has requested that construction be restricted to the period between June 1 and September 15, which is more restrictive than our Procedures (June 1 to September 30 for coldwater fisheries and June 1 to November 30 for warmwater fisheries). Millennium has requested a variance to extend the timing window to between mid April and November 2000 because of the presence of hard shale at the landfall that may increase the difficulty and duration of the directional drill. Millennium has not indicated if it would require a variance for construction of the offshore segment of Lake Erie. Variances from our timing windows would be allowed upon written site-specific notification by the appropriate state agency.

At the end of the directional drill, the drill opening would transition to the open trench and the exit hole would be the disposal site for the drilling fluids and drill spoil. The NYSDEC commented that alternative methods of disposal of these wastes should be considered. Drilling fluids used in directional drill construction are mostly composed of fresh water modified with a viscosifier. The viscosifier used almost exclusively in drilling fluids is a naturally occurring clay (bentonite) that is typically found in Wyoming and South Dakota and is classified as a non hazardous waste by the NYSDEC and the EPA. Polymers (such as polyanionic cellulose, sodium carboxymethyl cellulose, and starch) are added to the bentonite to enhance (or increase) the yield. For use in drilling fluids, Wyoming bentonite yields in excess of 85 barrels per ton. The addition of polymers to produce a high yield bentonite can increase the yield to 200 barrels per ton of material. Typically, directional drill fluids are high yield bentonite composed of less than 4 percent viscosifier by volume, with the remaining components water and drilled spoil.

Millennium estimates that the drilling fluids (composed of about 2,000 cubic yards of spoil, 4,000 cubic yards of extended bentonite, and 575,000 barrels of water) would be discharged from the exit hole and would remain in suspension as a turbidity plume before eventually settling out. Based on turbidity plume modelling for current volocities ranging from 0.4 to 8 inches per second and on the assumption that the settled drilling mud would not be resuspended and dispersed by stronger currents, Millennium estimates that the thickness of drilling mud deposits on the fine bottom substrate (located about 4,430 feet from the exit hole and 7,050 feet from the shore) would range between 0.0047 and 0.094 inches. Millennium further states collection of the drilling fluids from the bottom of the lake would be impractical since the majority of the material is water and only about 4 percent by volume is actual bentonite.

The physical disruption of sediment habitat by jetting would affect benthic faunal communities. Sediment deposition from trenching would typically be limited to within 300 feet on either side of the trench, with a maximum predicted sediment depth of about 2.5 inches near the trench. Once construction is complete, recolonization by benthic communities would be rapid, since most of the species present in the project area are tolerant of disruption. The effects of increased turbidity from trenching or inadvertent drilling mud releases on fish populations would likely be minimal, localized, and temporary. Fish spawning would likely not be affected since the water depth at the directional drill exit and the lake bottom trenching would be greater than 20 feet. However, pelagic larval fish present offshore and other adult fish species that prefer bottom habitat would be temporarily displaced from the project vicinity.

5.3.4 Hudson River/Haverstraw Bay

The Hudson River would be crossed at MP 387.9 in the Haverstraw Bay area, approximately 9.5 miles north of Nyack, New York, and the Tappan Zee Bridge. According to the NYNHP, the project would be within or adjacent to a designated Significant Coastal Fish and Wildlife Habitat that is part of the state's Coastal Management Program (NYSDEC, 1999). The proposed crossing would be 2.2 miles long, making directional drilling infeasible as a construction option. However, the shallow, slow-moving water and sandy bottom at the crossing location would facilitate the use of the open-cut construction method.

Millennium would use two dredge barges to excavate the trench and install the pipeline. The pipe used to construct the crossing would be encased in about 6 inches of concrete for protection and to ensure negative buoyancy. During constuction, the trench would be up to 130 feet wide at the top in the shipping channel, up to 70 feet wide at the top in other areas outside of the shipping channel, and about 10 feet wide at the bottom. Trench depth in the shipping channel would be about 20 feet and 10 feet in areas outside the shipping channel. The trench would be excavated over a period of about 60 days, the pipe installed in five days, and the trench backfilled over a period of about 30 days. During trenching, dredged material would be stockpiled in the river on both sides of the trench. To ensure that fish movement in shallow areas is not blocked by underwater spoil piles, Millennium would install breaks in spoil piles. Millennium would not place spoil above the waterline. During dredging and backfilling operations, turbidity curtains would be used to reduce sediment transport. Following backfilling, the minimum cover over the pipeline would be 15 feet in the shipping channel and 5 feet outside the shipping channel. If sufficient backfill material is not available to reach this depth, cover material that meets COE specifications would be imported and delivered to the trench with hopper barges that have bottoms which can be opened over the trench. Cover would be redistributed as necessary using mechanical means. As proposed, the crossing would be completed during the winter months between November 1 and January 31.

The NYSDEC commented that alternative dredging techniques should be considered and that additional information should be provided on the total volume of sediments to be dredged. Millennium responded that there are basically two dredging methods that could be used for the Hudson River crossing: mechanical and hydraulic. Millennium proposes to use mechanical dredging to meet the 3-month construction window and estimates that about 200,000 cubic yards of material would be excavated. This assumes a trench that is 20 feet deep in the navigation channel, 10 feet deep outside the navigation channel, and about 10 feet wide at the bottom with a side slope of 3:1. Using standard mechanical dredging equipment available in the region, trench preparation can be completed in about 2 months and backfill in 1 month.

According to Millennium, hydraulic dredging requires loosening the material to be removed, mixing it with water, and then pumping it as a slurry through a floating pipeline to an upland or in-river disposal area. The slurry is typically about 10 percent excavated material and 90 percent water. Assuming the same side slope (3:1) and trench depth (10 feet outside the navigation channel, 20 feet in the navigation channel), but allowing for a 20 foot wide trench because of how the hydraulic dredge works, about 700,000 cubic yards of material would need to be excavated. Completing the crossing within the time window could be affected because of the disposal requirements and the lack of hydraulic dredging equipment in the region. If only one hydraulic dredge is used, construction could take up to 7 months.

One of the issues associated with the use of hydraulic dredging is the disposal area. Millennium estimates that the storage and dewatering of 700,000 cubic yards of material could require as much as 50 acres of land; if multiple dredges were used, the land requirements could increase to as much as 100 acres. There are no disposal sites at the crossing location on either shore that could handle this volume of material and material would have to be trucked further inland. Although material could be stored in the river, sedimentation would be significantly increased both during excavation and backfill because the sediments are suspended by the hydraulic action and would take longer to settle out. Short-term turbidity would be higher than with the use of mechanical dredging. Other options would include temporary spoil storage on barges.

Given the timing window, the length of the crossing, the depth of the trench, and the problems associated with storage of the material from the hydraulic dredge, we believe that mechanical dredging may result in less environmental impact than hydraulic dredging. However, the COE may attach additional conditions to its permits.

GAI Consultants, Inc. (1998) conducted studies for Millennium in the summer of 1998 to predict the transport of suspended solids and associated contaminants within the Hudson River resulting from the installation of the pipeline. The model predicted a visible plume about 330 feet wide by 5,100 feet long during excavation (assuming TSS would have to be 70 mg/l to be visible). On a daily basis, the plume would cover an area of about 38.0 acres. As trenching progresses across the bay the visible plume would follow active trenching. Over the duration of construction , the modeling indicates that a visible turbidity plume would be present temporarily over about 1, 383 acres. Dredging operations would increase TSS concentrations to about 160 to 379 mg/l at a distance of about 165 feet from the dredging site. Assuming that Haverstraw Bay occupies about an 11 square mile area, the daily visible plume would be expected to occupy about 0.5 percent of the bay on any given day.

The TSS concentrations during backfilling of the pipeline would be expected to be similar to the plume during excavation. However, the length of the plume during backfilling would be expected to be twice the size of the plume during excavation because backfilling would proceed at twice the distance each day. The visible plume on any given day during backfilling would cover an area of about 77.0 acres. The total area covered by a visible plume during backfilling would be the same as the area affected by trenching, about 1,383 acres.

The model assumed a constant streamflow in the downstream direction, thereby providing a conservative estimate of the distribution of the TSS plume since the reversing currents (tidal influence) would tend to limit the extent of the TSS by moving some of the suspended solids in the upstream direction. Since it is not likely that dredged materials would be stable enough to permit materials piled in the river to protrude above the water surface, the model simulations did not account for any TSS caused by erosion of dredged material stored above the water.

The modeling by GAI Consultants, Inc. also included a sensitivity analysis to determine how the predicted turbidity levels would change under varying conditions. The sensitivity analysis predicted that the resultant TSS concentrations would be significantly reduced by decreasing the dredge bucket size and/or by reducing the cycling time. Both measures would require a longer construction period. While lowering the predicted TSS concentrations in the bay is an obvious benefit of employing either of these measures, this benefit must be weighed against the negative impacts of extending the construction period beyond the proposed 90-day window. The plants and animals residing in the bay are diverse and are sensitive to disturbance at different times during the year. A longer construction period would conceivably increase the number of sensitive periods that would be overlapped.

In fact, reducing the proposed construction period, and perhaps increasing TSS concentrations, could have less of an impact on the bay environment than prolonging the construction period to decrease TSS concentrations. The crossing time could be reduced by concurrently employing more dredging operations than currently proposed. The "in river" time might also be reduced if an alternative crossing method were used which employs directionally drilling the banks and shallows of the Hudson River, if feasible. This would reduce the area within Haverstraw Bay directly affected by dredging and the time needed for this phase of construction. The feasibility of alternative approaches to completing the crossing of the Hudson River have not been provided by Millennium. Therefore, we recommend that:

- **Millennium coordinate with the COE, NMFS, and NYSDEC to evaluate the feasibility and associated impacts of:**

    a. using alternative construction measures, such reducing the dredge bucket size and/or dredge cycle time, that would limit the TSS concentrations in Haverstraw Bay;

    b. employing multiple dredging operations to expedite the crossing time;

    c. directionally drilling the banks and shallows of the Hudson River; and

    d. other strategies or combinations, such as smaller dredge buckets on multiple dredging operations, that would minimize impacts to the bay and its biota.

    The findings of this evaluation and all associated correspondence with the identified agencies should be filed with the Secretary before the end of the DEIS comment period.

The NYSDEC commented that additional cores should be collected at the crossing location because of the known presence of PCBs near the project site. Millennium stated that PCBs were not detected in the samples collected but that it would be willing to discuss additional sampling as part of the Hudson River crossing plan. Therefore, we recommend that:

- **Millennium shall, in consultation with the COE, NMFS, and NYSDEC develop an in-stream monitoring plan for the Hudson River for PCBs, TSS, lead, and mercury which includes mitigation actions to be taken at specific pollution thresholds. The plan shall be filed with the Secretary prior to sampling for review and written approval by the Director of OPR.**

Releases of organic and inorganic contaminants from excavated sediments during construction activities would be expected to increase bioaccumulation and decrease biological productivity of the fish and invertebrate communities present in the immediate vicinity of the proposed crossing. In general, based on the EPA marine acute criteria, acute impacts to aquatic life are predicted within about 655 feet from the crossing location. The effect of the contaminants present in the excavated sediments would be localized and temporary, and rapid dispersion would be expected. The model appears to underestimate the potential for resuspension of sediments from the spoil pile in shallow areas from wind and wave action; however spoil piles are not expected to protrude above the water surface.

We have also reviewed the site-specific crossing plan for the Hudson River. Spoil would be placed as a non-continuous berm on both sides of the trench. In shallow areas, breaks would be placed in underwater spoil piles to ensure adequate corridors for fish movement. Turbidity curtains would be utilized during trenching and backfilling to slow sediment migration. However, Millennium's site specific crossing plan does not address how material dredged from the shipping channel, which could amount to hundreds of cubic yards, would be handled. Because of the sensitivity and importance of Haverstraw Bay as estuarine fish habitat, we recommend that:

- **Millennium revise its site-specific crossing plan for the Hudson River to address specifically where trench spoil would be stored both in-river and on river banks. The site-specific plan should be developed in consultation with the COE, NMFS, and NYSDEC and should be filed with the Secretary for review and approval by the Director of OPR before construction.**

To minimize adverse impacts to fisheries, Millennium proposes to cross Haverstraw Bay during the winter months (November 1 to January 31) when biological rates (i.e. food consumption and metabolic rates) are at their lowest. This would minimize impact on recruitment and spawning since most species spawn in the spring and early summer when water temperature rises. However, pipeline construction during the winter months may have an adverse effect on fish using the estuary as juvenile and adult overwintering grounds (i.e., striped bass, Federally endangered shortnose sturgeon, American shad). See additional discussion in section 5.6.

5.4 FISHERIES AND WILDLIFE RESOURCES

5.4. Fisheries Resources

Potential impacts to streams from pipeline construction have been widely studied. These studies have generally indicated short-term impacts on coldwater and warmwater streams and no long term adverse effects on water temperature, pH, dissolved oxygen, benthic invertebrate populations, or fish populations (Vinikour et al, 1987, Blais et al, 1997). The studies indicate that in-stream TSS concentrations increase during construction, but decrease after construction activities are completed.

5.4.1.1 General Construction and Operational Impacts

Impact on fishery resources, such as sedimentation and turbidity, acoustic shock, destruction of stream cover, introduction of water pollutants, or entrainment of fish, could result from construction activities. To minimize these potential impacts, Millennium would adhere to the protective measures outlined in its ECS, which incorporates the FERC's Procedures. In addition to these protective measures, other Federal, state, or local agencies may require Millennium to follow more stringent procedures.

Sedimentation and Turbidity

Increased sedimentation and turbidity from construction have the greatest potential to adversely affect fisheries resources. However, impact on fisheries from construction-induced sedimentation and turbidity would be reduced to short-term, temporary disturbances if the measures contained in the ECS and Procedures are followed. These include the following requirements.

- Construction of stream crossings would be limited to the period of June 1 through September 30 for coldwater fisheries, unless otherwise permitted or further restricted by state agencies. In New York, the NYSDEC has recommended a June 1 through September 15 construction window for most crossings. This restriction would minimize sedimentation and turbidity induced by seasonal high flow volumes, limiting impact on spawning areas that may be present in or downstream of crossing areas.

- Trench spoil from minor and intermediate waterbody crossings would be stored in upland areas at least 10 feet from the streambanks and would be protected with silt fence, hay bales, or other erosion control devices that would prevent or reduce sediment runoff from entering the stream.

As previously discussed, the use of directional drilling or dry-crossing construction techniques would eliminate most of the potential for construction activities to increase sedimentation and turbidity in waterbodies. Standard wet-crossing (open-cut) techniques could elevate the concentration of suspended solids, but the elevated levels would be relatively high for only short periods and short distances downstream of the crossing. Overall, the impact of construction on benthic macroinvertebrates and fish would be minimal and short term. Increased suspended sediment concentration levels during construction could increase invertebrate drift and reduce fish feeding for brief periods. However, Millennium is required by our Procedures to complete most in-stream work in less than 48 hours at each individual stream. Therefore, impact would be temporary, and suspended sediment concentrations would return to background levels soon after construction in each stream is completed.

Turbidity resulting from suspension of sediments during in-stream construction or erosion of cleared right-of-way areas could reduce light penetration and photosynthetic oxygen production. Additionally, resuspension of organic and inorganic materials can cause an increase in biological and chemical uptake of oxygen, resulting in a decrease in dissolved oxygen. Ponds, lakes, reservoirs, and slow-moving streams that have thick organic sediment deposits often experience a decrease in oxygen at the sediment-water interface, particularly during the summer months when bacterial respiration is high and chemical oxidation is greatest (Wetzel, 1983). Resuspension of this type of sediment could result in localized depletion of oxygen throughout the water column, which could temporarily displace fish from the affected area. As previously mentioned, warmwater fishes have survived short-term TSS concentrations of between 20,000 and 100,000 mg/l.

Acoustic Shock

Some stream crossings may require blasting of bedrock, which, due to acoustic shock, could be harmful to fish in the immediate vicinity of the explosion. The degree of impact would depend on the type of explosive, blasting technique, fish species, and timing. Teleki and Chamberlain (1978) conducted experiments on the survival of various species following detonation of charges placed in bedrock or mud of a lake bottom. Based on data presented by Teleki and Chamberlain (1978), laterally compressed fish (e.g., pumpkinseed, crappies) were the most sensitive to blast-related acoustic shock and would suffer 95 percent mortality within 213 feet of the detonation, decreasing to 10 percent mortality at 472 feet of the detonation. The least sensitive fish were those with more rounded body forms (e.g., suckers, trout) which would suffer 95 percent mortality within 174 feet of the blast, dropping rapidly to 10 percent mortality at 194 feet. Teleki and Chamberlain (1978) suggest that active construction in the stream area (i.e., drilling for the blast charges) would scare most fish out of the area prior to construction. Millennium would use scare charges in streams with important fisheries if recommended by the state.

Cover Loss

Streambank vegetation, in-stream logs, rocks, and undercut banks provide important cover for fish. Some in-stream and shoreline cover would be altered or lost at the stream crossings and fish that normally reside in these areas would be displaced. However, these effects would be relatively minor because of the small area affected at each stream. In addition, the Procedures limit vegetation maintenance on streambanks and allow for long-term revegetation of all shoreline areas with native herbaceous and woody plant species, except for a 10-foot-wide corridor over the pipeline.

Other Impacts

Other potential effects of construction include interruption of fish migration and spawning, entrainment of fish, and mortality from toxic substance (fuel) spills. Entrainment of fish during hydrostatic testing would not likely occur during withdrawal of water, since intakes would be screened as required by the Procedures. However, fish larvae and eggs could be entrained if present in the source water. The timing restrictions in our Procedures and those that may be requested by other resource agencies are designed to minimize this likelihood since construction activities are largely restricted to times outside of fish spawning periods.

Direct spills into streams could be toxic to fish, depending on the type, quantity, and concentration of the spill. To reduce the potential for direct surface water contamination, Millennium would refuel equipment and store fuel and other potentially toxic materials at least 100 feet from waterbodies or would implement the special precautions outlined in its SPCC Plan.

5.4.1.2 Site Specific Impact

Based on preliminary consultations with the NMFS, FWS, and NYSDEC, and other New York state agencies, Millennium identified 85 perennial and 31 intermittent waterbodies as designated trout waters or streams suitable for trout spawning. Of these, nine waterbodies may require trench blasting: Bear Brook (MP 286.0), Tributary Sands Creek (MP 287.0), Tributaries East Branch Delaware River (MPs 288.0 and 289.0), Gee Brook (MP 291.0), Hoolihan Brook (MP 297.0), Tributary Basket Creek (MP 298.0), Tributary Delaware River (MP 300.0), and Shin Hollow Brook (MP 342.0). According to our Procedures (see section V.B.7.d and V.B.8.c) the 24- or 48-hour clock for completing an open cut through minor or intermediate waterbodies, respectively, does not include the time that may be needed for blasting.